



Digitizing Paleogene Mammals from the Rocky Mountain Region

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Introduction

Early fossil mammals are very small and generally represented in the fossil record only by the part of their bodies most resistant to decay: their teeth. Fortunately, the features of mammalian dentition are frequently diagnostic of genus, if not species. Accurate tooth measurements and access to comparative material expand the potential for identification of fossil mammal species.

The University of Colorado Museum of Natural History (UCM) Fossil Vertebrate Collection is engaged in a Institute of Museum and Library Services (IMLS) funded digitization project of Paleogene mammal specimens from the Rocky Mountain Region (CO, UT, WY, NM, and SD). The UCM fossil vertebrate collection comprises nearly 100,000 catalogued specimens, many of which are mammalian teeth and jaws. The project will produce up to 4,400 high resolution, focus-stacked, TIFF images of 1,100 identified fossil mammal species, over a period of 2 years.

The Imaging System

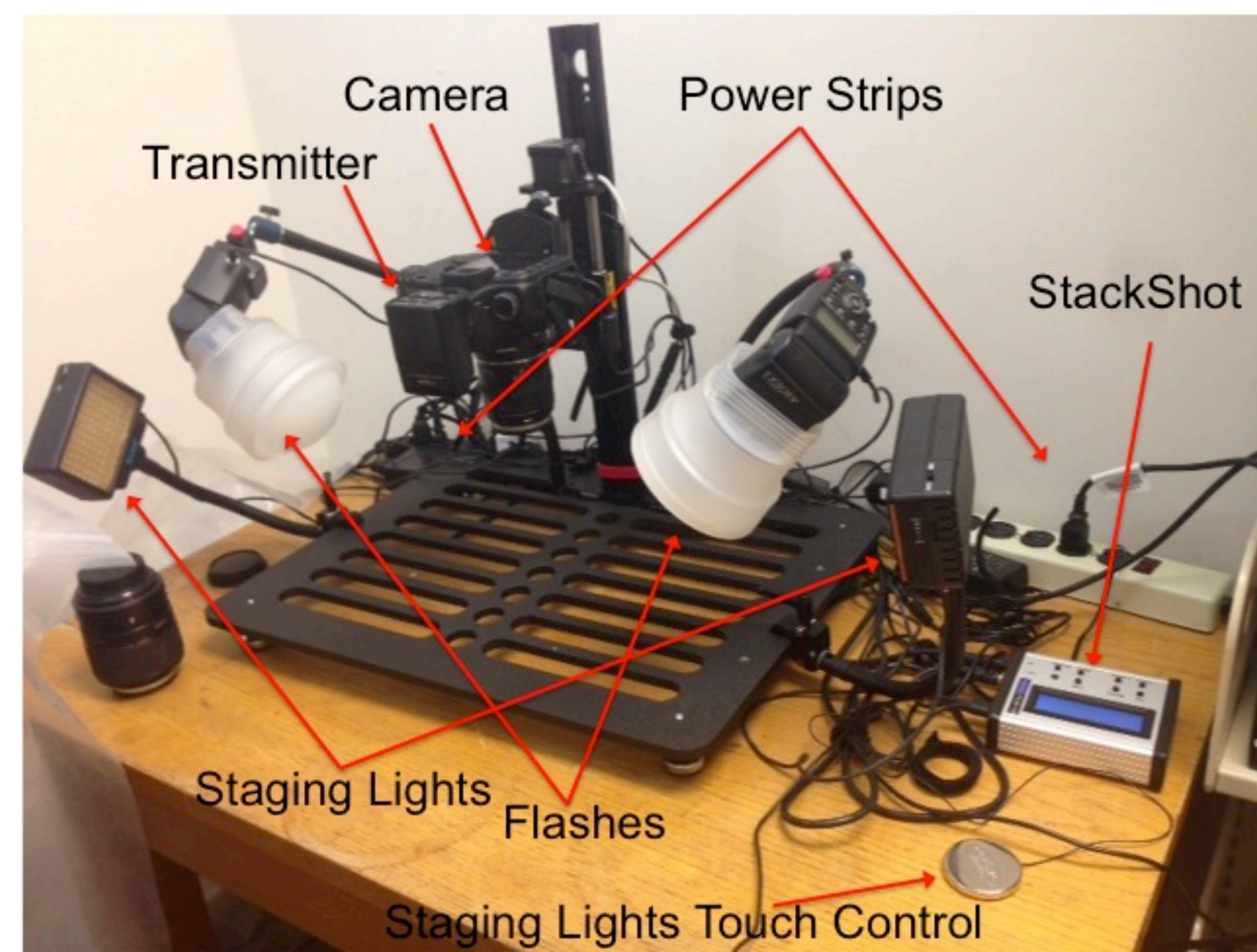


Fig 1. UCM imaging system

Hardware and Software

Our system uses a Canon 5D Mark II and the following lenses:

- Canon MP-E 65mm f/2.8 1-5x Macro
- Sigma 50mm f/2.8DG Macro

The StackShot Macro Rail Package by COGNISYS controls focus-stacking

Programs used in imaging process:

- Passport II Imaging System
- Canon EOS Utility
- Helicon Focus
- Lightroom
- Photoshop CS6

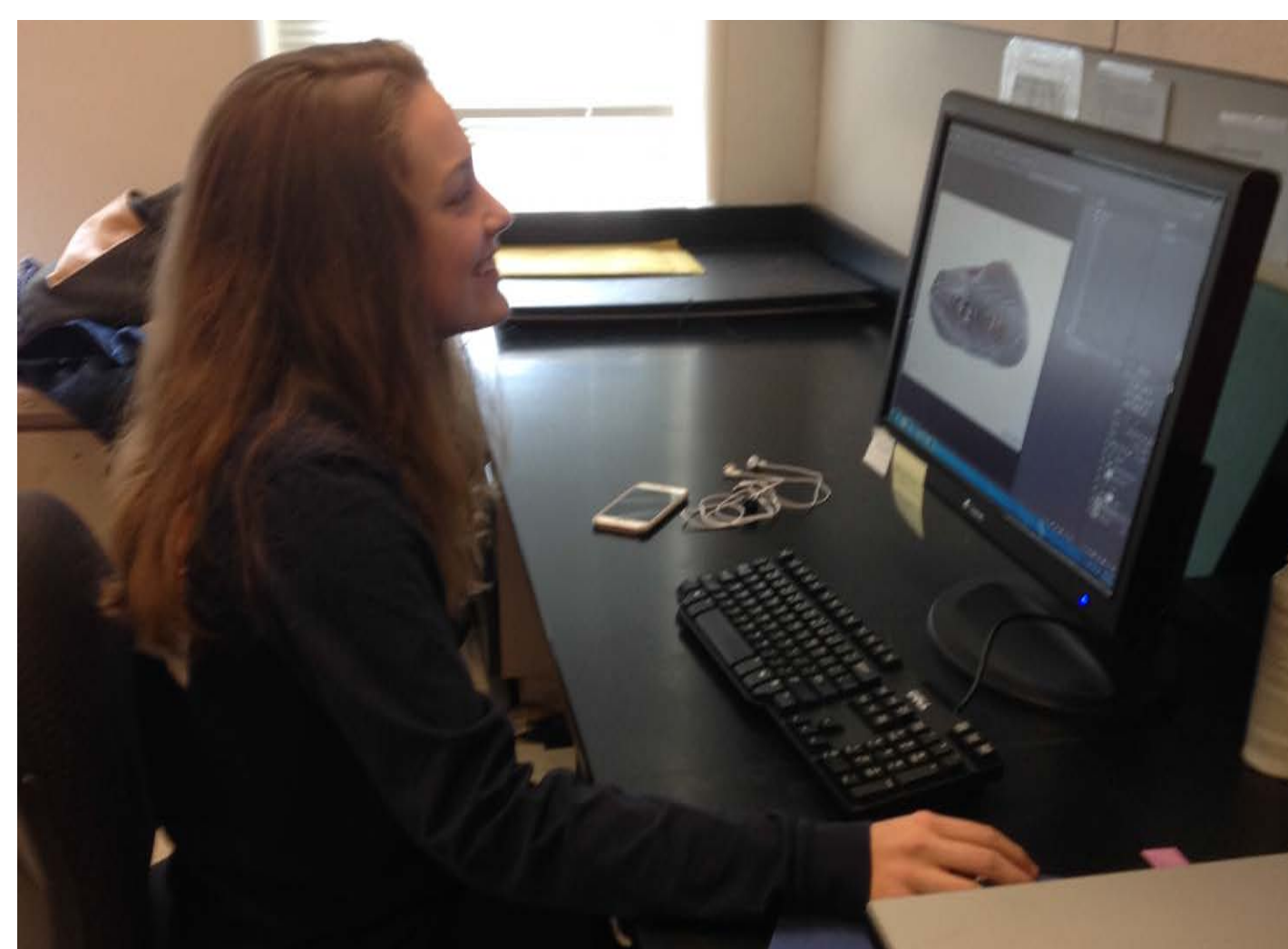


Fig 2. Madelaine Atteberry processing images

Image Capture, Processing, and Editing

The specimens are photographed systematically throughout the depth of field. Composite, focus-stacked images are made with Helicon Focus and then edited in Photoshop CS6. The final images include a scale bar and UCM catalog number. Ryan Allen of the University of Colorado Herbarium wrote two Photoshop CS6 scripts for the imaging station system to help streamline the editing process and reduce errors. The first script assists in placing the scale bar, and the second recognizes the filename of the image to place the UCM identification number and perspective on the image. An "Unsharp Mask" is also applied to the edited image to accentuate details. Different sharpen amount percentages are used depending on the size of the specimen. The "Unsharp Mask" parameters were chosen based on trial and error. An unedited original is always saved.

Image Standards and Uses



Fig 3. Research quality images of fossil primates *Cantius* and *Notharctus*

As we choose specimens, we look for examples of both upper (maxillary) and lower (dentary) dentition in an attempt to represent every species from each NALMA (North American Land Mammal Age) in our collection. We then take high resolution images of the occlusal, labial, and sometimes lingual perspectives of the fossil teeth.

Focus Stack Photography

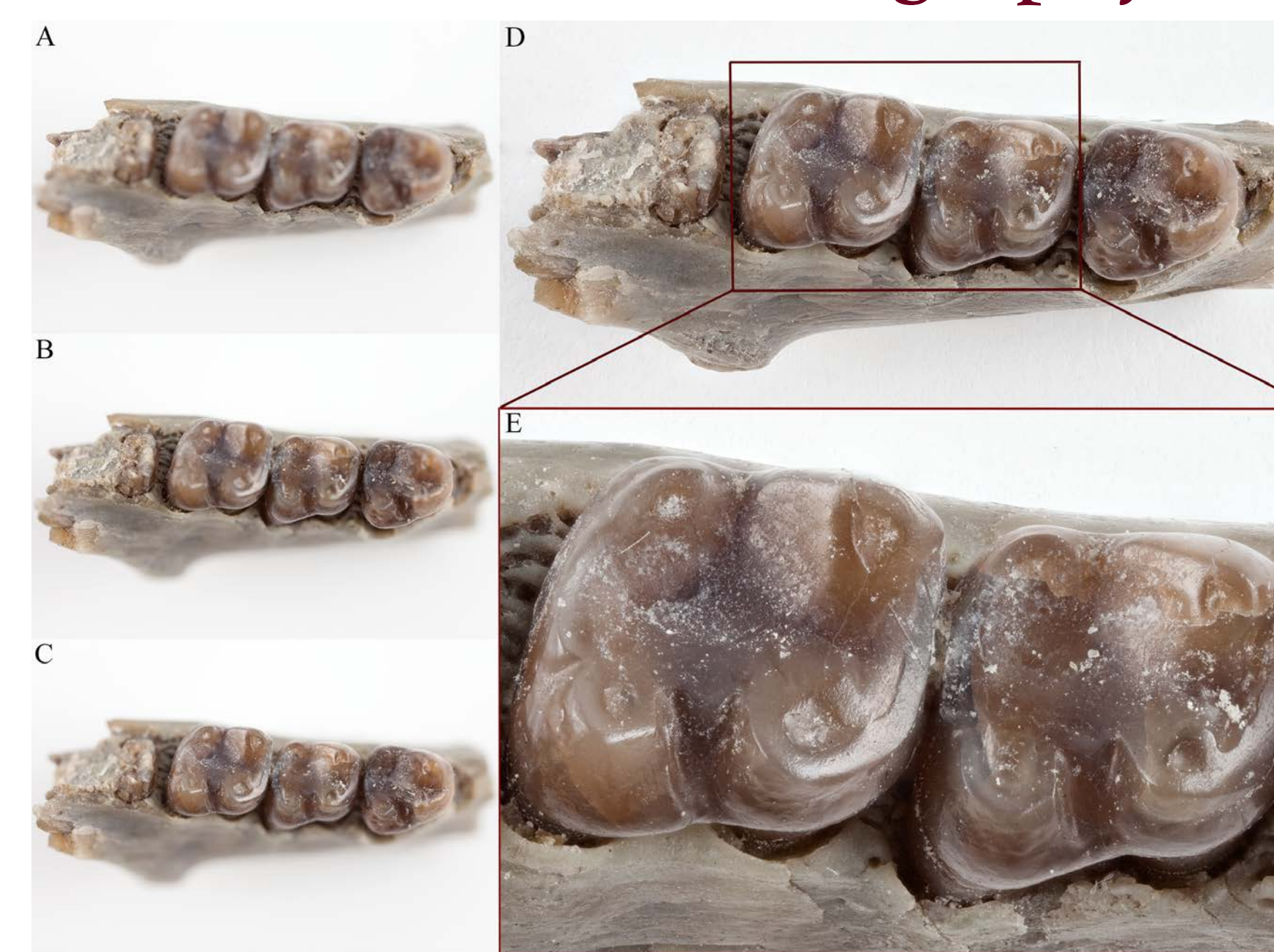


Fig 4. Focus-stacking captures a high level of detail (5616 x 3744 pixels) & greater depth of field than a single image (A-C). Photo D is a composite of 57 images taken with a 65mm macro lens at 1.5x magnification. (Lower jaw of fossil rodent, *Leptotomus* UCM 67731).

Dust Map



Fig 5. High resolution image of fossil rodent *Sciuravus* before and after dust map application.

The dust map function in Helicon Focus uses algorithms to edit out dust on the lens and sensor which would usually appear in the final stacked image. The program does this based off of a plain white photograph that we take regularly (a photograph of a white background, at the highest magnification of the lens being used, taken out of focus, with the highest shutter speed). This saves us money and time when the local camera shop is busy.

Workflow for Creating Images

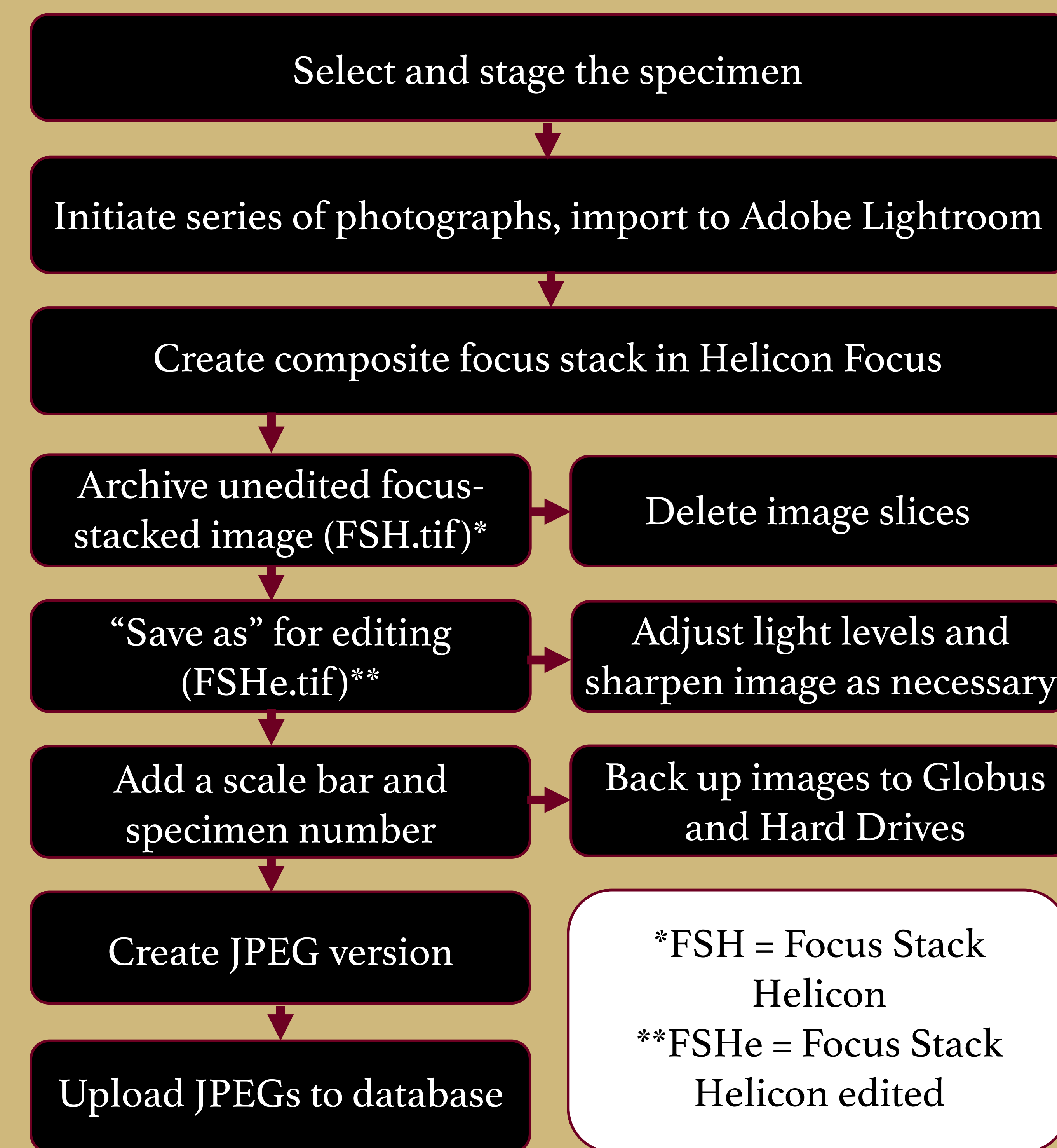


Image Storage and Access

Collective Access and GLOBUS

All images are backed up to multiple hard drives in multiple locations and uploaded to the Cloud, using the server GLOBUS, as well as the University of Colorado network server. The images are copied and JPEG-formatted to be shared on the UCM fossil vertebrate collection's online database "CollectiveAccess". At the completion of the project, the images will be published to the online public portal, [iDigBio](#).

The online availability of the JPEG images through CollectiveAccess allows the public to view specimens from any location. The TIFF images are available on request to researchers. Through this project, the preservation of the specimens will be enhanced by the reduction in physical handling; e-loans help prevent damage and loss.

Acknowledgements

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